INTRODUCTION TO COMPUTATIONAL PHYSICS, INC.

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Presenters:

Dr. Douglas Strickland (Science)
Mr. Charles Poole (Software Engineering)

OVERVIEW

- Founded in 1984
- Founder and CEO: Dr. Douglas J. Strickland
- Work Sites
  - Springfield VA (Headquarters)
  - Naval Research Laboratory, Washington DC
  - Boulder CO
  - Boston MA
  - Brunswick ME
  - Tucson AZ
- What We Do

  Atmospheric and space sciences including remote sensing algorithm development and applications, semantic sensor web development, software requirements, agile software engineering, and distributed scientific computing.

CPI's UNIQUE EXPERTISE

- Physical Sciences
  - Basic research
  - Applied research and development
- Software and Computational Methods
  - Full-life cycle software development
  - State-of-the-art software engineering techniques
- Synergy Between Science and Software
  - Computational methods adopted, adapted, and extended to advance the physical sciences
  - Knowledge of physical patterns used to enhance computational methodologies

PROVEN PERFORMANCE

- Long-Term Relationship with Customers
  - 21 continuous years supporting NRL
- Long Record of Peer-Reviewed Research Publications
- Science Algorithms in Use for NASA and DoD Satellite Missions
- Operational Data Production and Validation
  - "Excellent" performance ratings from NASA
- Validated Products Used within Scientific and Software Communities
  - First-principles physics-based models
  - Middleware software

KEY CUSTOMERS IN FY06

- NRL (three divisions)
- NASA (directly and through Aerospace Corp.)
- NPOESS (through Ball Aerospace, APL and NRL)
- MDA (through NRL and Raytheon/Photon Research Associates)
- NRO (through NRL)
- DMSP (through Aerospace Corp.)
- NSF

PHYSICAL SCIENCES EXPERTISE

- Atmospheric Radiative Transfer
- Charged and Neutral Particle Transport
- Internal / Gravity Wave Physics
- Ionospheric Physics
- Radio Wave Propagation
- Radio Interferometry
- Cloud Physics and Radiative Properties
- Climate Modeling and Prediction

PHYSICAL SCIENCES CAPABILITIES

- Remote Sensing (EO/IR, Microwave)
- Modeling Atmospheric Processes
- Parameterization of Physical Phenomena for Operational Uses
- Ionospheric Applications
- Data Fusion
- Sensor Performance & Calibration Assessments
- Science Support to Optical and Particle Sensor Programs
- Optical Backgrounds Characterization

REMOTE SENSING

- Dominant & Trace Species, Temperature, Ocean Winds, Energy Inputs, Ionosphere
- Geophysical Retrieval Algorithms
  - Emission, limb scattering, occultation
  - Multiple platforms & viewing geometries
  - Passive microwave polarimetry
- Generic Implementation of Optimal Estimation, Including Detailed Error Analysis and Retrieval Characterization Package

MODELING ATMOSPHERIC PROCESSES

- State-of-the-science First-principles Models
  - Dayglow/nightglow
  - Aurora
  - Ionosphere
  - Inversion of remote sensing data
  - Mountain waves (Earth and Mars)

SOFTWARE ENGINEERING EXPERTISE

- Application of State-of-the Art Software to Scientific Problems
- Full-life Cycle Software Development
- Agile Development Best Practices
- Architectures for Distributed Modeling and Simulation
- Architectures for Semantic Sensor Webs
- Conceptual Modeling (Domain Models, Ontologies)

SOFTWARE ENGINEERING CAPABILITIES

- Semantic Sensor Web Development
- Distributed Modeling and Simulation
  - Component-based integration
  - Legacy interfaces
- Scientific Visualization
- Project and Requirements Management
- Conceptual Modeling
- Middleware Development
  - Developed Enterprise Java CORBA Component Model (EJCCM)
  - http://www.ejccm.org
- Application and Model Re-engineering
- Grid Parallelization
  - Earth System Modeling Framework (ESMF) using MPICH
  - Globus Toolkit v4.0
- Agile Software Engineering (XP, Scrum, CMM(I), EVM)

SEMANTIC SENSOR WEB

- Internally Developed Architecture for Web Service (WS) Based Semantic Sensor Web (SSW) Concept
  - Improves large scale sensor web capabilities by exposing ontology based search and registry capabilities
  - Supports knowledge based software agents
  - Use of open standards (WS-Resource Framework, OGC-Sensor Observation Service, OWL-S, etc.)
  - Development of services supporting models as sensor web assets
  - Development of sensor web application development environment (business process based planning tool concept)
- SSW Concept Used As the Basis for Proposals to NASA and ONR to Support Semantic Based Sensor and Model Integration in a Sensor Web Context for Earth Science and Global War on Terror
- On Going Work to Develop Prototype Core Services

DISTRIBUTED MODELING & SIMULATION

- Applied Information Systems Research Program (AISRP)
  - NASA program
  - Built on EJCCM
- Battlespace Environment and Signatures Toolkit (BEST)
  - Missile Defense Agency (MDA) program
  - Built on EJCCM
- Navy Integrated Earth and Space Environmental Model (NIESEM)
  - ESMF

SUMMARY

- Excellent Long-term Relationships with Customers
- Long history with NASA Programs
- Basic and Applied Research in Atmospheric and Space Sciences
- Scientific Software Engineering
- Looking Forward to the Opportunity to do Business with JPL